J. FIELDING.

METHOD OF MANUFACTURING HEADERS FOR WATER TUBE BOILERS AND THE LIKE.

APPLICATION FILED JULY 6, 1909.

993,974.

Patented May 30, 1911.

2 SHEETS—SHEET 1.

Fig. 1.

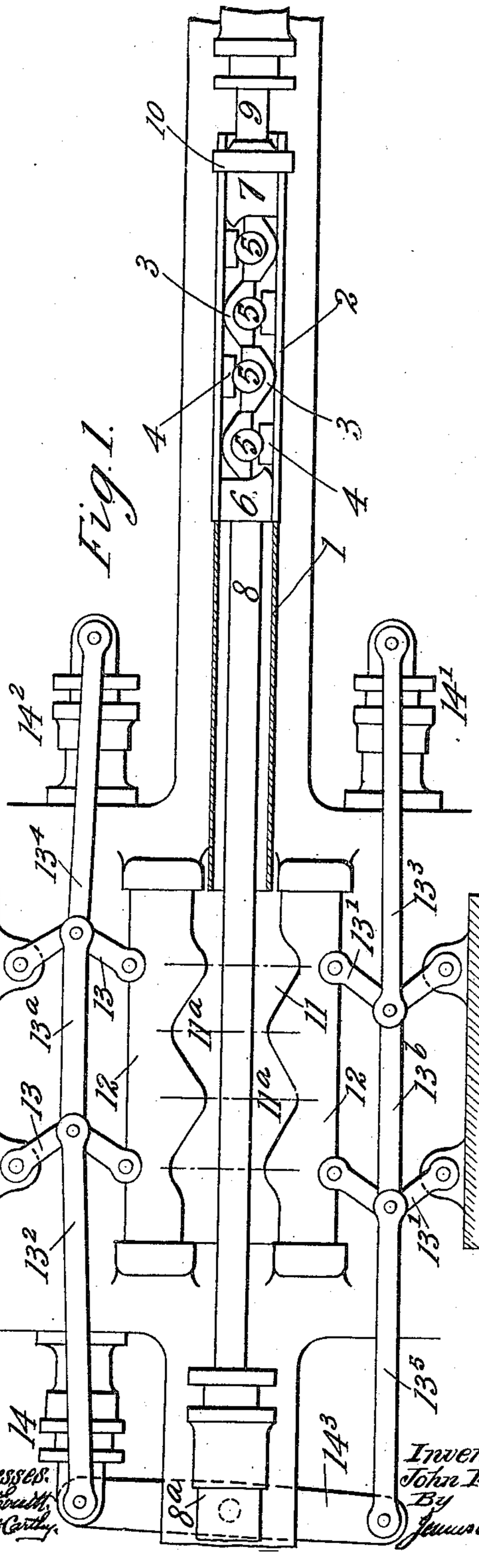
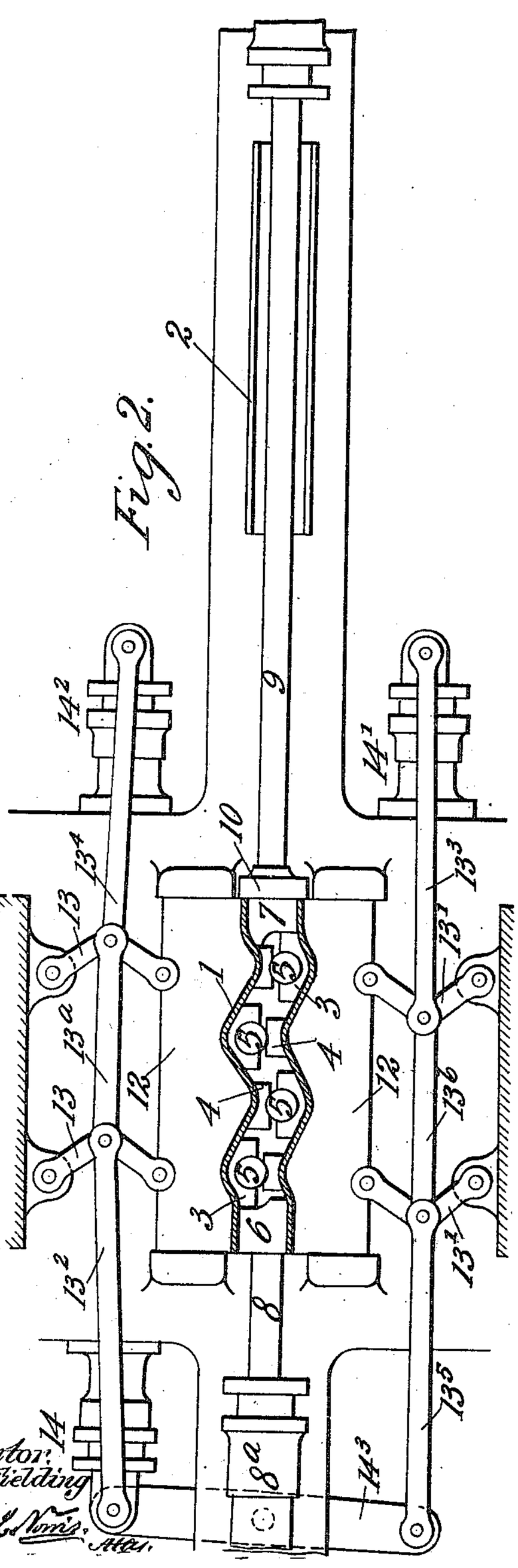


Fig. 2.



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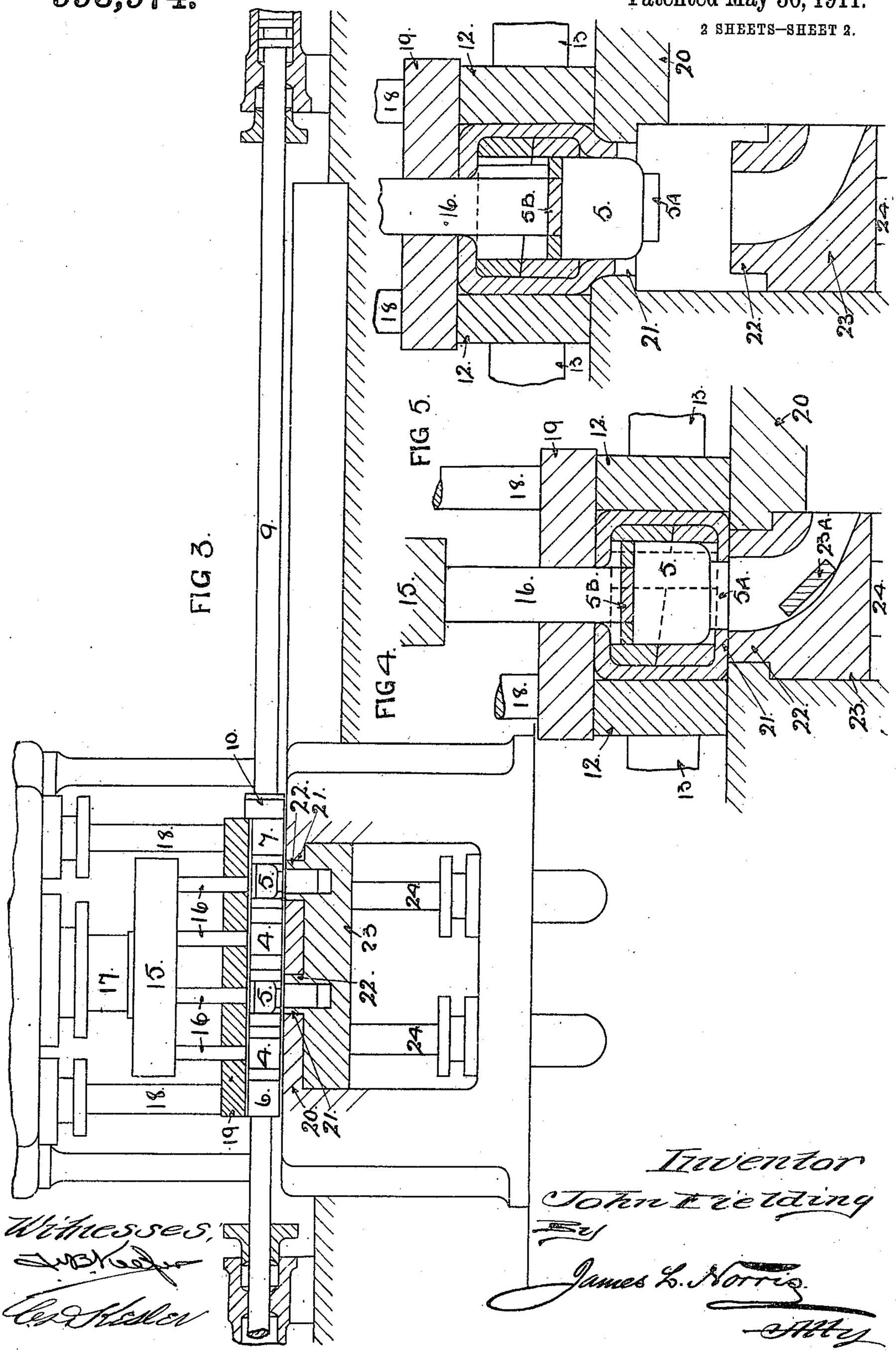

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METHOD OF MANUFACTURING HEADERS FOR WATER-TUBE BOILERS AND THE LIKE.

993,974. Specification of Letters Patent. Patented May 30, 1911.

Application filed July 6, 1909. Serial No. 506,071.

To all whom it may concern:

Be it known that I, JOHN FIELDING, a subject of the King of Great Britain, residing at Atlas Works, Gloucester, in the county of Gloucester, England, engineer, have invented a certain new and useful Improved Method of Manufacturing Headers for Water-Tube Boilers or the Like, of which the following is a specification.

This invention refers to serpentine headers for tubulous boilers or the like and consists in an improved method of making such headers.

Tubular blanks have been given an irregular outline by either inclosing them in suitable dies and subjecting them internally to fluid pressure to force the blank out against the walls of the incasing dies, or by inserting in the blank a collapsible sectional mandrel having depressions on its sides corresponding to the required form and held together and in place by a central core, then placing the blank between upper and lower dies with plain faces and side dies with depressions on their acting faces corresponding to the projecting surfaces of the serpentine faces of the mandrel, and forcing the dies together to produce the desired form; but in both these methods the boring or punching and flanging of the tube and hand holes have constituted separate operations. It has been proposed also to insert metal plates in a punching and forming machine and to move the plates forwardly or in an outward direction against dies carried by the machine, whereby holes are punched in the plates, backwardly or inwardly directed flanges imparted to the margin of each hole and the plates themselves convexed in the outward direction, but these plates thus punched and formed would have to undergo a separate and subsequent operation in order to form them into serpentine headers for tubular boilers.

According to the present invention by means of internal and external punches and dies of suitable shape and coöperating together, the operations necessary to impart to the tubular blank which is to constitute the header a sinuous or serpentine shape, also to punch holes in one face of the blank and to punch and outwardly flange a series of holes in another face, are all carried out successively but substantially simultaneously and with one heating and one working of the tube blank whereby a considerable saving of labor and time is effected.

The external dies consist of a pair of plane surface dies between which the tube is firmly held on two opposite faces; there are also a pair of corrugated pressing dies, one or both of which are operated by suitable means, such as hydraulic rams, to give the serpentine form to the other faces of the tube. The first pair of dies are fitted with punches and dies placed at suitable centers for the purpose of punching and flanging the tube holes as will be hereinafter described.

The internal dies consist of as many pairs of convex and concave dies as there are intended to be tubes in the header; these are specially constructed so that they may be easily removed from the finished tube. These convex and concave dies are held in their relative positions in regard to each other by a central punch which forms a sort of key to them, the convex die of one pair faces one side of the tube, while that of the adjacent pair faces in the opposite direction, and so on, the convex dies are D-shaped and fit around rather more than half the circumference of the central punch, so that when put into the straight tube their sides butt against each other and thereby maintain the correct pitch from center to center of the punches and dies, these centers being arranged to agree with those of the corrugations and punches in the external dies.

The internal dies are held in their proper positions by dies which enter the ends of the header, and are urged inward preferably by means of hydraulic rams. One of these end dies and hydraulic rams are used to push the internal dies into the tube from a channel or guide in which they are placed in readiness. When the corrugated external dies are pressed upon the tube, the internal dies prevent the collapsing of the tube, but each pair follows the movement which takes place as the tube is pressed into serpentine form. When thus pressed, the centers of the internal punches are brought into line with the punches on the external dies already referred to.

There are punches in one of the plane surface dies only, the opposite plane surface die being bored large enough to form the mold or die into which the adjacent side of the tube is to be flanged after punching, and within this flanging mold is fitted a sliding punching die having a central hole corresponding

to but somewhat larger than a projection which is formed upon the central internal punch. This sliding die is held level with the surface of the external die during the punching operation. In the other end of the central internal punch is bored a recess somewhat larger in diameter than the punch in the corresponding external plane die and of a depth about equal to the thickness of the adjacent side of the tube.

When the punches in the external die are forced forward the side of the tube nearest is punched, the metal being forced into the recess in the internal punch, the recess being thus filled up; the continued advance of the external punch forces the internal punch forward punching the other side of the tube. Both sides being thus punched the sliding die above referred to is released or withdrawn and the central punch is driven out of the tube thus forming the flange around the hole last punched. The punching and corrugating dies are then drawn back and the tube taken out and the convex and concave dies can now be removed; these dies are made each in two pieces to allow of this being done.

The improved method of manufacture will be described with reference to one form of apparatus suitable for carrying out the invention, which apparatus is illustrated in the drawings accompanying this specification, in which—

Figures 1 and 2 are plans of the apparatus in two positions; Fig. 3 is a sectional elevation; and Figs. 4 and 5 are sectional views of the apparatus drawn to a larger scale.

In Fig. 1 the plain tube which it is intended to form into a corrugated and flanged header and which is preferably of rectangular section, is shown at 1 heated ready for being operated upon; 2 is an open channel or box in which are contained the internal dies 3, 4, punches 5 which are pressed together by end dies 6, 7, and these latter dies are operated by hydraulic rams 8 and 9. Water being exhausted from cylinder 8^a of ram 8, the dies are pushed by ram 9 into the tube 1, and as soon as the crosshead 10 on ram 9 comes against the rear end of the tube 1, the latter is pushed forward along with the internal dies into the space 11 until the centers of the punches 5 are coincident with the lines 11^a which intersect the axes of two holes 21 (see Fig. 3) in the bottom plate 20 of the external mold or die, which holes act as dies for flanging the lips of the hand or other holes to be formed on the header. When the tube is in this position it is subjected to lateral pressure from the corrugating dies 12 operated by suitable gear such as the toggle links 13 and hydraulic rams 14. Preferably these rams are connected by some convenient gear to insure their simultaneous operation so that the dies 12 may be advanced together equally toward the axis of the tube, until the parts occupy the position shown in Fig. 2, that is until the corrugation or sepentine form of the tube is complete. One arrangement for connecting the cams is shown in Figs. 1 and 2. The toggle links are connected together and with the ram 14 by linkage 13^2, 13^a, and links 13′ are connected to ram 14′ by linkage 13^3, 13^b. Links 13 are also connected to a ram 14^2 by a link 13^4, and links 13′ are connected by means of link 13^5 and pivoted beam lever 14^5 to ram 14. Rams 14 and 14′ when operated actuate the links 13 and 13′ to cause corrugating dies 12 to move toward one another, and ram 14^2 actuates the links to cause a return motion of the dies.

Fig. 3 shows in sectional elevation the same parts and also the arrangement of the punching and flanging dies. In this view the parts already described are indicated by the same numbers as in the previous views, other parts being a crosshead or platen 15 carrying the punches 16 and operated by a suitable hydraulic ram 17. 18, 18 are a pair of hydraulic rams working on the plane surface die or plate 19 which forms the top of the external mold or die and acts also as a guide for the punches 16. This plate 19 can be lifted high enough to allow of the easy removal of the finished header. 20 is a plate which forms the bottom of the external mold and has holes 21 bored in it to form the mold for flanging the lips of the holes to be formed on the header. These holes are shown in the drawing, Fig. 3, as filled up by members 22 carried or formed upon a moving or sliding table 23 operated by rams 24. The members 22 serve as dies for the holes to be punched in one of the sides of the tube. The operation of punching and flanging is described with reference to Figs. 4 and 5 in which the different parts are numbered as before. These figures are transverse sections through one pair of the holes 21.

Fig. 4 shows the punching operation; Fig. 5 the method of flanging the lip. The internal punching die 5 is operated by the punch 16 and ram 15. The sliding punching die 22 has a central hole 22^a corresponding to but somewhat larger than a projection 5^a formed upon punch die 5, and during the punching operation it is raised by rams 24 so that it enters hole 21 and is held there level with the top of internal die 20, Fig. 4. In the upper end of the die 5 is bored a recess 5^b somewhat larger in diameter than the punch 16 and of a depth about equal to the thickness of the tube in that part.

When punch 16 is pressed by platen 15 and ram 17 it first punches one plane face of the tube and the punched disk is forced out and fills up recess 5^b. As punch 16 ad-

vances farther the internal punch 5 is forced forward to punch the other plane face of the tube. The sliding punch die is then withdrawn, and the internal punch is drawn farther out of the tube and thus forms a flange around the hole last punched. The disk 23ª last punched out either falls out of or can be removed from the table 23. The external punching and corrugating dies are now drawn back, the tube removed from space 11 and the convex and concave internal dies withdrawn from the tube by any suitable means.

Having thus described the nature of my said invention and the best means I know of carrying the same into practical effect, I claim:—

1. A method of forming an integral tubular blank into a corrugated or serpentine header for a tubulous boiler and holeing it in one operation, which consists in pressing the blank, while the latter is stationary, in two opposing directions to impart a serpentine form thereto, punching holes in the blank, said holes having axes transverse to the said direction, and flanging outwardly the margins of the holes.

2. A method of forming an integral tubular blank into a corrugated or serpentine header for a tubulous boiler and holeing it in one operation, which consists in first pressing the blank, while the latter is stationary, in two opposing directions to impart a serpentine form thereto, then punching from without the blank a series of holes therein, having axes transverse to the said directions, then punching from within the blank a second series of holes, and finally flanging outwardly the margins of the second series of holes.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOHN FIELDING. [L. S.]

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